DRAFT

Board No I

R E V E R S A L P R O C E S S I N G S T U D Y

STAT

PAR-206

Final Report 1 April 1965

"Reversal Processing of High Resolution Films Study"

Declass Review by NGA.

STAT STAT 1. INTRODUCTION: We have a contract [redacted] initiated in May 1963 with [redacted] for "Empirical Studies in Photo Exploitation." On 6 February 1964 we authorized, under this contract, the initiation of a study in reversal processing as applied to high resolution aerial reconnaissance films. This work is identified as PAR 206 and a final report of this effort entitled "Reversal Processing of High Resolution Films Study" was published under date of 1 April 1965.

Photography is normally considered a negative-to-positive system in that an increase in explosure results in the product having an increase in the developed silver (density).

There are several photographic processes which produce the opposite effect, that is, an increase in exposure appears as a decrease of the processed image density. These negative to negative or positive to positive processes are referred to as reversal processing.

In the reversal technique the negative and positive images are each generated successively in a single emulsion layer or photographic film. The negative silver image, which is produced in the first development step, is chemically dissolved out of the emulsion in a bleach solution. The partially processed photographic material is then re-exposed, by subjecting it to controlled light, (or it may be subjected to chemical fogging), after which it is re-developed forming an image of the opposite polarity, or positive image in the previously un-exposed portion of the emulsion.

The study was confined to only one of several available reversal techniques; this particular one is most suited to the processing of original aerial photographic films and aerial photographic duplicating films.

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2. DISCUSSION: This chart illustrates the relative processing steps of the standard negative process versus the reversal process beginning with the exposed original camera film.

In the standard negative process, the film having been exposed to form a latent image is developed to form a negative metalic silver image. The film is then "fixed" to remove the un-exposed silver salt and the product obtained is a first generation original negative.

In the reversal process, the exposed film is first developed to form a negative metalic silver image, but is not fixed to remove the un-exposed silver, only the metalic silver image is then dissolved in a bleach bath and the remaining previously un-exposed silver halide grains are now exposed and re-developed to form a new metalic silver image having a polarity which is the reverse of the original negative image. The film is then fixed to complete the operation resulting in an obtained product of a first generation positive.

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In this chart we see the required steps involved for both the standard negative process and the reversal process, to produce a duplicate negative from a developed and fixed original negative.

In the standard process a duplicating film is exposed through the first generation negative (commonly referred to as printing), which, after developing and fixing, results in a second generation duplicate positive.

Next another duplication film is again exposed through the now second

generation positive and after developing and fixing results in a third generation duplicate negative.

In the reversal process the duplicating film having been exposed through the first generation negative is developed in a manner similar to that for standard processing, however, from this point on the process is quite different from that of standard processing, the developed image is now bleached out and the previously un-exposed areas are exposed and re-developed, which after fixing results in a second generation duplicate negative.

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On this chart we see some typical comparisons of reversal and standard processing, an 800 line per millimeter 1000 / 01 high contrast 6th root of 2 USAF resolution test target was used to represent the first ~~second~~ generation negative, (in this case the target had clear bars on a black background). This target was reproduced on type 8430 high resolution duplicating film.

Although the numbers shown on this chart represent the results of about 500 targets that had received variations in exposure and processing, a word of caution against jumping to conclusions from the numbers shown here, is in order. They are intended only to show trends or relative effects and not absolute values. As can be seen a reversal processed duplicate negative (no 317) can be expected to have substantially higher resolution than a standard processed duplicate negative (278) due to the elimination of one printing operation; and the reversal processed duplicate will have tone and contrast characteristics more closely resembling those of the original negative than will the standard processed duplicate.

It does not necessarily follow, however, that a print from the reversal processed duplicate will have higher resolution than one from a standard

processed duplicate, on the contrary, as can be seen by comparison of the numbers 198 for the third generation positive and 221 for the fourth generation positive that one can expect a lower resolution number for the print from the reversal duplicate due to the lower contrast and other modulation transfer characteristics. This does not necessarily mean that there has been a loss of information due to reversal processing. In many cases it will be found that there is actually an increase of information content.

As can be seen from this chart, there are three printing operations involved in producing a duplicate positive or print by the standard process. This can be reduced to two (no 556 and 249) by the reversal process.

Although not shown on this chart the camera film can be reversal processed to provide a first generation original positive, in which case the resolution numbers for the first generation positive would be almost double the 556 shown for the second generation positive by standard processing.

All of the resolution figures shown are based on the use of current film types 3400, 3401, and 3404 for the camera negative and 8430 for duplicates both negative and positive. These figures apply only to these films and do not hold for other type films.

In Summary: A camera film reversal processed to a first generation positive will provide maximum information; and can be expected to produce duplicate negatives almost equal to those obtained from a second generation positive.

Reversal processing can achieve higher resolutions and improved tone and contrast by eliminating some of the printing operations.

Reversal processing can reduce the required number of laboratory operations and expendature of time and materials for a duplicate negative by eliminating the second generatinn positive from production chain.